

Appl. No. 10/711,015
Amdt. dated April 13, 2006
Reply to Office action of March 15, 2006

Amendments to the Claims:

1. (Currently amended) A copper damascene process, comprising:
forming a dielectric layer overlying a substrate;
etching a damascene opening into said dielectric layer;
5 filling said damascene opening with copper or copper alloy;
treating a surface of said copper or copper alloy with hydrogen-containing plasma;
reacting said treated surface of said copper or copper alloy ~~with trimethylsilane or~~
~~tertramethylsilane~~ under plasma enhanced chemical vapor deposition (PECVD)
conditions comprising simultaneously supplying trimethylsilane or tertramethylsilane and
10 initiating plasma to make said trimethylsilane or tertramethylsilane react with said treated
surface of said copper or copper alloy; and
in-situ depositing, by PECVD, a silicon carbide layer capping on said copper or
copper alloy.
- 15 2. (Original) The copper damascene process according to claim 1 further comprising:
lining said damascene opening with a diffusion barrier layer;
forming a seed layer on said diffusion barrier layer; and
forming said copper or copper alloy on said seed layer.
- 20 3. (Original) The copper damascene process according to claim 1 wherein said
damascene opening comprises a contact or via hole in communication with a trench
opening.
- 25 4. (Original) The copper damascene process according to claim 1 wherein the step of
reacting said treated surface of said copper or copper alloy with trimethylsilane or
tertramethylsilane comprises following processing parameters: a trimethylsilane (or
tertramethylsilane) gas flow in the range of 100 to 5000 sccm; a process temperature in
the range of 300°C to 450°C; and a reaction duration in the range of 0.1 seconds to 30

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seconds.

5. (Currently amended) A copper damascene process, comprising:
forming a dielectric layer overlying a substrate;
5 etching a damascene opening into said dielectric layer;
filling said damascene opening with copper or copper alloy;
treating a surface of said copper or copper alloy with hydrogen-containing plasma;
reacting said treated surface of said copper or copper alloy ~~with trimethylsilane or~~
~~tertramethylsilane~~—under plasma enhanced chemical vapor deposition (PECVD)
10 conditions comprising simultaneously supplying trimethylsilane or tertramethylsilane and
initiating plasma to make said trimethylsilane or tertramethylsilane react with said treated
surface of said copper or copper alloy; and
in-situ depositing, by PECVD, a silicon carbide layer capping on said copper or
copper alloy, said silicon carbide layer being treated with in-situ ammonia plasma to
15 remove contained oxygen of the deposited layer.
6. (Original) The copper damascene process according to claim 5 further comprising:
lining said damascene opening with a diffusion barrier layer;
forming a seed layer on said diffusion barrier layer; and
20 forming said copper or copper alloy on said seed layer.
7. (Original) The copper damascene process according to claim 5 wherein said
damascene opening comprises a contact or via hole in communication with a trench
opening.
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8. (Original) The copper damascene process according to claim 5 wherein the step of
reacting said treated surface of said copper or copper alloy with trimethylsilane or
tertramethylsilane comprises following processing parameters: a trimethylsilane (or

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tertramethylsilane) gas flow in the range of 100 to 5000 sccm; a process temperature in the range of 300°C to 450°C; and a reaction duration in the range of 0.1 seconds to 30 seconds.

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